

**U.S. FISH AND WILDLIFE SERVICE  
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM**

SCIENTIFIC NAME: *Notropis buccula* Cross

COMMON NAME: smalleye shiner

LEAD REGION: Region 2

INFORMATION CURRENT AS OF: October 14, 2005

STATUS/ACTION:

☐ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

☐ New candidate

☒ Continuing candidate

☐ Non-petitioned

☒ Petitioned - Date petition received: May 11, 2004

☐ 90-day positive - FR date:

☐ 12-month warranted but precluded - FR date:

☐ Did the petition requesting a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? Yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.

During the past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, emergency listings, and essential litigation-related, administrative, and program management functions. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (<http://endangered.fws.gov/>).

☐ Listing priority change

Former LP: ☐

New LP: ☐

Date when the species first became a Candidate (as currently defined): June 13, 2002

☐ Candidate removal: Former LP: ☐

☐ A – Taxon is more abundant or widespread than previously believed or not subject to

the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

\_\_\_ U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

\_\_\_ F – Range is no longer a U.S. territory.

\_\_\_ I – Insufficient information exists on biological vulnerability and threats to support listing.

\_\_\_ M – Taxon mistakenly included in past notice of review.

\_\_\_ N – Taxon does not meet the Act's definition of "species."

\_\_\_ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Fish, Cyprinidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Texas

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Texas

LAND OWNERSHIP: The smalleye shiner occurs in rivers, which are owned by the State of Texas. The majority of the riparian land ownership within the documented range of the shiner is private, with minor areas owned by the State (Parks), and Federal (Corps of Engineers) governments.

LEAD REGION CONTACT: Susan Jacobsen, 505-248-6641

LEAD FIELD OFFICE CONTACT: Arlington, Texas Field Office, Omar Bocanegra, 817-277-1100

## BIOLOGICAL INFORMATION

Species Description: The smalleye shiner (*Notropis buccula*) is a small (35 to 44 millimeter (1.4 to 1.7 inches [in]), pallid minnow endemic to the Brazos River Basin in Texas. Adult smalleye shiners have a long snout (greater than the distance from anterior tip of mandible to posterior tip of maxillary), eight principal dorsal fin rays, seven principal anal fin rays, and eight pelvic fin rays (Cross, 1953). As with other fishes of the family Cyprinidae, the smalleye shiner can prove difficult to separate from closely related congeners. Moss and Mayes (1993) found this confusion in historic collections to be most common with *N. potteri*, *N. shumardi*, and *N. stramineus*. For the identification of the smalleye shiner, it was determined that *N. shumardi* differs in body shape, depth of the caudal peduncle, and fin ray counts. *N. potteri* is distinguished from the smalleye shiner through a comparison of tooth count (0, 4-4, 0 in *N. buccula*), squamation patterns, and the smalleye shiner's posteriorly broadened upper lip. The report of *N. stramineus* from the Brazos River (Anderson et al., 1983) may be erroneous, due to the lack of supporting records (Moss and Mayes, 1993).

Taxonomy: The smalleye shiner was originally described as a subspecies of the Red River

shiner (*N. bairdi*), an endemic of the Red River system in Texas and Oklahoma, and subsequently elevated to species status (Hubbs, 1957). Although geographically separated, the smalleye shiner is apparently closely related to *N. bairdi* and the federally threatened *N. girardi*, which occurs in the Canadian River in Texas, and may share life history characteristics of these native prairie fishes. A review of current literature indicates the species is still a valid taxon (e.g., Nelson et al., 2004).

**Habitat:** Smalleye shiners require habitats almost identical to those of several other obligate riverine fishes native to Texas prairie streams (e.g., *N. oxyrhynchus*). Preferred habitat includes fairly shallow water (38 to 82 centimeters [15 to 32 in] in depth) in broad, open sandy channels with a moderate current (Moss and Mayes, 1993). Ostrand (2000) found abiotic factors associated with smalleye shiner habitat to include specific conductance < 30 mS, relatively high current velocity (> 0.20 m/s)(0.65 feet/s) and high turbidity (> 41 NTU). Within their preferred habitat, smalleye shiners are most often found using the center of the channel, avoiding the shallow depth and slow velocity of the stream edges (Moss and Mayes, 1993). Their diet consists mainly of aquatic insects, dominated by dipterans, and sand/silt suggesting they forage among the substrate (Marks et al. 2001). Although very little is known about the life history of this species, they are thought to be short-lived and spawn in early spring and summer (Moss and Mayes, 1993). Additional life history traits may be similar to those of congeners that inhabit prairie streams such as *N. girardi*, *N. bairdi*, and *N. oxyrhynchus*, which are thought to spawn primarily during flood events (Moore, 1944; Moss and Mayes, 1993).

The Brazos River watershed extends from eastern New Mexico southeasterly to the Gulf of Mexico. The basin is approximately 1,030 kilometers (km)( 640 miles [mi]) in length, encompasses approximately 118,103 square kilometers (45,600 square mi) (Dunn and Raines, 2001), ranges in width from 1.6 to 193 km (1.0 to 120 mi), and drains all or portions of 69 counties in Texas (Cronin et al., 1973) and three counties in New Mexico. The predominant land use within the basin is agriculture, dominated by cotton, corn, and sorghum, and open rangeland (Dunn and Raines, 2001). Within the Middle Brazos River Basin, a large percentage of agriculture consists of concentrated animal feeding operations (CAFOs) (Armstrong, 1998).

The Brazos River is a typical prairie stream. The main stem originates in the upper reach from the confluence of the Salt and Double Mountain Forks. This upper region of the watershed is highly variable with regard to flow and often becomes intermittent, forming isolated pools within the channel (Echelle, et al., 1972; Ostrand, 2000; Ostrand and Wilde, 2001). The river traverses through the Edwards Plateau Ecosystem and extends southeastward through the East Texas and Texas Gulf Coast Ecosystems (USFWS, 1994).

Since the early 1900s, significant reservoir construction has occurred within the Brazos River Basin. By 1986, 1,165 minor and 13 major reservoirs, three of which occur on the main stem of the Brazos River, were listed in the Texas Natural Resource Conservation Commission's (TNRCC) dam inventory (Dunn and Raines, 2001). From 1941 to 1969, the rate of reservoir construction increased substantially and included Possum Kingdom Reservoir in 1941, Whitney Reservoir in 1951, and Granbury Reservoir in 1969, which are located on the main stem Brazos River, as well as six other major reservoirs within the watershed (Dunn and Raines, 2001). A

new reservoir, Alan Henry Reservoir, impounded the Double Mountain Fork of the Brazos River in October 1993 (Wilde and Ostrand, 1999), to serve as a future water supply for the City of Lubbock (LEWPG, 2001). The effects of reservoir construction in the Brazos River Basin since 1953 have resulted in significant temporal changes to its fish assemblage (Anderson et al., 1995; Hubbs et al., 1997; Wilde and Ostrand, 1999).

Historical Range/Distribution: The smalleye shiner historically occurred throughout the Brazos River proper, the Double Mountain and Salt Forks of the Upper Brazos River drainage and within the Lampasas River, a tributary of the Brazos (Moss and Mayes, 1993). The type locality is from the main stem Brazos in Palo Pinto County, where 14 specimens were collected in 1952 (Cross, 1953). A population may exist in the Colorado River above Buchanan Reservoir (Hubbs et al., 1991) and is presumed to be introduced; however, information on the status of this population is lacking.

Moss and Mayes (1993) conducted an extensive study of the distribution of the smalleye shiner and sharpnose shiner (*N. oxyrhynchus*) within the Brazos River Basin. The study included a review of known museum, university, and other collections (from 1951 to 1986) to determine the historical distribution of both species. Their review indicated the smalleye shiner historically occurred at nine main stem sites, six sites on the Double Mountain Fork of the Brazos River, 14 sites on the Salt Fork of the Brazos River, one site on the North Fork Double Mountain Fork, and one site on the Lampasas River. The collections included specimens from the Upper, Middle, and Lower Brazos River systems (Sellers, 1996), ranging from the upper reach of the North Fork Double Mountain Fork in Garza County, Texas, to the southernmost site in Brazos County, Texas.

Of the known historical records of smalleye shiners from the Brazos River Basin examined by Moss and Mayes (1993), 24 collections were taken from the Upper Brazos River drainage, the majority of which were located on the Double Mountain and Salt Forks of the Brazos River. The Double Mountain Fork collections (one sample from 1978 and five from 1986) consisted of 351 specimens collected from sites in Garza, Kent, Fisher, Stonewall, and Haskell Counties. The Salt Fork collections (two samples from 1951, one from 1953, one from 1960, one from 1968, one from 1984, and eight from 1986) contained 492 specimens collected from locations in Kent, Stonewall, Knox, Baylor, and Young Counties. Main stem records from the Upper Brazos consisted of a single specimen collected in 1986 from one site in Young County, and 26 specimens collected from three sites (one from 1951 and two from 1952) in Palo Pinto County. The Palo Pinto County collection includes the holotype and paratypes from the original description.

The remaining nine historical records reviewed by Moss and Mayes (1993) included 16 specimens collected from one site on the Middle Brazos River (Bosque County) in 1952, and 79 specimens collected at eight sites between 1940 and 1976 from the Lower Brazos River (Bell, Brazos, and Burleson Counties). The Lower Brazos specimens include the sample from the Lampasas River in Bell County.

Current Range/Distribution: Moss and Mayes' (1993) assessment of the declining distribution of

the smalleye shiner within the Brazos River Basin was based on the historical records compared with their sampling of the basin from October 1988 through August 1991. Sampling sites were selected based on all known localities of the smalleye shiner within the basin (37 sites), most of which (26 sites) were located in the Upper Brazos River Basin, including 24 sites upstream of Possum Kingdom Reservoir. From these upstream samples, a total of 2,388 smalleye shiners were collected from nine sites on the Salt Fork (Kent, Stonewall, Knox, Baylor, and Young Counties), four sites on the Double Mountain Fork (Garza, Kent, Fisher, and Stonewall Counties), three sites on the North Fork Double Mountain Fork (Garza County), and one site on Croton Creek (Kent County), a tributary of the Salt Fork. Two samples taken from the main stem Brazos downstream from Possum Kingdom Reservoir in Palo Pinto County and collections made on two sites on the Clear Fork of the Brazos River (Shackelford and Fisher Counties) did not include smalleye shiners. The smalleye shiner has apparently never been documented from the Clear Fork.

The remaining 11 sampling sites were located within the Middle (Parker and Falls Counties) and Lower Brazos River Basin (Milam, Brazos, Washington, Austin, Fort Bend, and Bell Counties), which included two sites on the Lampasas River. No smalleye shiner was discovered among the collections made at these sites.

Although the smalleye shiner is currently one of the dominant fishes at certain sites within the Upper Brazos drainage and historically occurred within the Middle and Lower Brazos River, it has apparently been extirpated from the basin downstream of Possum Kingdom Reservoir. Ostrand (2000) estimated the current population of smalleye shiners within the Upper Brazos to represent 17% of the fish assemblage. Surveys were conducted at two sites on the North Fork Double Mountain Fork (Garza County), three sites on the Double Mountain Fork (Garza, Kent, and Fisher Counties), five sites on the Salt Fork (Kent and Stonewall Counties), and three sites on the Brazos River proper (Knox County). Smalleye shiners were present at all 13 sites (6,558 collected) where they represented one of the seven dominant species within the study area (Ostrand, 2000).

The few recent surveys that have been made within the Middle and Lower Brazos do not provide evidence of the persistence of the smalleye shiner within this region. A survey from the Lampasas River (Lampasas and Bell Counties) for the purpose of conducting an index of biotic integrity was completed in 1998 (Armstrong, 1998). From two sites on the Lampasas River, a total of twenty-two species of fish were identified. No smalleye shiners were collected. The smalleye shiner has apparently not been collected from the Lampasas River since 1951.

Winemiller and Gelwick (1999) conducted an assessment of stream integrity in 1998 using fish collected within the Middle and Lower Brazos River, including many of the river's tributaries. Six sites utilized in the study were on the main stem Brazos River in McLennan, Falls, Robertson, Washington, and Fort Bend Counties. These collecting efforts produced 53 species of fish; however, no smalleye shiners were collected.

Most recently, a survey was conducted specifically for sharpnose shiner in the Middle (Falls County) and Lower Brazos River (Austin, Brazos, Fort Bend, and Robertson Counties),

including two sites on the Lampasas River, in 2000 and 2001. The sharpnose shiner is an endemic fish of the Brazos River that utilizes similar habitats of the smalleye shiner. The results of the survey indicated that no smalleye shiners were present within this portion of their historical range (Wilde and Bonner, unpublished). In 2003 and 2004, fish samples from the Lower Brazos River (Brazoria, Burleson and Washington Counties) reported 51 species from over 150,000 individuals collected; no smalleye shiner were collected (Winemiller et al., 2004).

The population of smalleye shiners within the Upper Brazos River drainage (upstream of Possum Kingdom Reservoir) is apparently stable. Downstream from the reservoir, the shiner has not been collected since 1976 and in all likelihood is completely extirpated representing a reduction of approximately 54% of its historical range.

## THREATS

A. The present or threatened destruction, modification, or curtailment of its habitat or range. The most significant threat to the existence of the smalleye shiner is the present and continued modification of its habitat attributable to anthropogenic factors. These factors include reservoir construction, in-stream sand and gravel mining, irrigation and water diversion, sedimentation, industrial and municipal discharges, agricultural activities, and the spread of invasive saltcedar.

*Reservoirs* - River impoundments adversely affect downstream fisheries by altering temperature regimes, flow rates, substrate, water quality, and nutrient availability (Anderson et al., 1983; Baxter, 1977). The downstream effects of impoundments often create a benign habitat within the channel, restricting its use to those species that proliferate in deep, incised channels. The significant changes to fish assemblages, including the local extinction of species, produced by downstream effects have been well documented (Gore and Bryant, 1986; Anderson et al., 1983). Reservoirs also fragment riverine habitat prohibiting the completion of the life cycle for those species that require an unimpeded stream for spawning and/or migration.

The downstream effects of reservoirs have altered the habitat within the Brazos River, impacting the fish assemblage. The Morris Sheppard Dam, which impounds Possum Kingdom Reservoir, incorporates hydroelectric generators, which utilize stored water through releases from the dam dependent on pool elevation and local power needs. These hypolimnial releases have modified the thermal regime up to 120 km (75 mi) downstream and along with the associated chemical modifications are likely responsible for the extirpation of at least four species of fish in the downstream reach (Anderson et al., 1983). In addition to the thermal and chemical alterations affecting fish assemblages, flow regime regulated by dams restricts habitat availability for many fish species (Bain et al., 1988). The marked decrease in fish diversity and decrease in abundance of cyprinids documented within the Brazos River Basin are also likely due to habitat modifications such as reservoir construction (Anderson et al., 1995).

Changes in channel morphology and substrate have also taken place within the Brazos River due to major impoundments (e.g., Allen et al., 1989; Gillespie and Giardino, 1997). Restriction of natural stream flow and sediment transport often contributes to channel incision and narrowing. The transport of sand through the Brazos River system has decreased in part due to reservoirs

(Mathewson and Minter, 1981; Dunn and Raines, 2001). Mathewson and Minter (1981) suggested that the major reservoirs trap approximately 76% of all sand produced within the Brazos River Basin.

Collections made by Moss and Mayes (1993) revealed a distinct difference between the fish assemblage upstream and downstream from Possum Kingdom Reservoir. They suggested that the effects of reservoir construction on the downstream channel have modified the habitat, excluding many native prairie minnows while generalist cyprinids have prospered. Anderson et al. (1983) noted the change created by the construction of the reservoir from sandy bottom and high turbidity (typical smallmouth shiner habitat) to clear, gravel bottom habitat for a distance of 30 km (19 mi) downstream from the Morris Sheppard Dam. Within this reach, seven species not normally found in the non-impacted reaches of the Brazos River (i.e., upstream from the reservoir), including two exotic species, had invaded the modified channel (Anderson et al., 1983).

In addition to the impacts of Possum Kingdom Reservoir on the Brazos River, two other impoundments occur on the main stem Brazos. Granbury Reservoir, approximately 258 km (160 mi) downstream from Possum Kingdom, and Whitney Reservoir, approximately 92 km (57 mi) downstream from Granbury, have also contributed to the modified habitat within the Middle and Lower Brazos River, which is most likely no longer suitable for the smallmouth shiner.

Reservoir construction on rivers also affects instream habitat and biotic communities upstream of the impoundment, which may include the extirpation of obligate riverine fish (e.g., Winston et al., 1991). Ecological imbalances can occur when facultative riverine fish propagate in reservoirs and disperse into upstream reaches (Winston et al., 1991). Impoundments also present a barrier, preventing upstream migration and/or dispersal, and may cause local extirpations in upstream areas (i.e., headwaters) subject to drought or other natural disturbances (Wilde and Ostrand, 1999).

A study of the effects of the recently constructed Alan Henry Reservoir on the Double Mountain Fork of the Brazos River (Garza County) on prairie stream fish was performed by Wilde and Ostrand (1999). This segment of the Double Mountain Fork is in a semi-arid region (precipitation 46-71 cm/yr) where flow is intermittent and dependent on rain events. During the absence of flow, the stream is characterized by isolated pools that provide the only habitat for fish until the next rain event, which may not occur for several months. Following the impoundment of the river, the upstream reach showed a dramatic change in the fish assemblage, including a decrease in cyprinids and increase in abundance of cyprinodontids (Wilde and Ostrand, 1999). This study indicated that one species of fish has been extirpated from the upstream reach, and another, the smallmouth shiner, has been significantly reduced in numbers, and may soon be extirpated. The disappearance of the fish is attributed to the lack of reproduction and/or survival occurring in isolated pools combined with the inability of the downstream population to recolonize the area due to the barrier created by the impoundment.

*Future Reservoir Development* - As required by Senate Bill 1 (enacted by the 75<sup>th</sup> Texas Legislature in 1997), Water Planning Regions within the State of Texas have developed and

finalized Regional Water Plans for the purpose of addressing future water needs. The Regional Water Plans are incorporated into an overall State Water Plan addressing water management, development, and conservation for the 50-year period from 2000 to 2050.

The majority of the Brazos River Basin falls within the Regions G (Brazos) and O (Llano Estacado) Water Planning Areas. Among the water management strategies detailed in the Region G Water Plan, one major reservoir and five minor reservoirs are recommended for providing water supply for the region (TWDB, 2002). The proposed Little River Reservoir would be located in Milam County on the Little River just upstream from the confluence with the Brazos River and would store between 180,000 and 903,000 acre-feet of water. The five minor off-channel reservoirs within Region G are Meridian, Somervell, Groesbeck, New Throckmorton, and Brushy Creek. The water rights for Groesbeck Reservoir have been obtained and authorize the diversion of 2,500 acre-feet of water per year from the Navasota River in Limestone County.

In addition to these potential reservoir projects recommended in the State Water Plan, several potential reservoirs are included in the Region G Plan for consideration during subsequent planning cycles or to meet water supply needs beyond the year 2050. They are as follows:

- Breckenridge Reservoir (= Reynolds Bend), would be located in Throckmorton County and impound the Clear Fork of the Brazos River just downstream from the confluence with Paint Creek and is anticipated to store 600,000 acre feet of water;
- South Bend Reservoir, would be located in Young County immediately upstream from the confluence of the main stem and the Clear Fork of the Brazos River, capturing flow from both channels, and storing up to 745,800 acre feet of water;
- Paluxy Reservoir in Somervell County, would impound the Paluxy River, a tributary of the Brazos, and store 99,700 acre-feet of water;
- Bosque Reservoir, would be located in Bosque County on the North Bosque River, a tributary of the Brazos, approximately four miles upstream from the City of Meridian and would store 102,900 acre-feet of water;
- Millican Reservoir, which was originally authorized by the U. S. Congress in 1968 and has subsequently been studied for feasibility at two sites on the Navasota River; the Panther Creek site located approximately 13 miles southeast of the City of Bryan (Brazos, Madison, and Grimes Counties) would store 1,973,000 acre-feet of water, and the Bundic Dam site, located between SH 21 and US 79 (Brazos, Robertson, Madison, and Leon Counties) would store 228,000 acre-feet of water;
- Peach Creek Reservoir, would be located in Brazos County and impound Peach Creek and divert water from the Navasota River for the storage of 14,511 acre-feet of water;
- Little River Off-Channel Reservoir would be constructed on Beaver Creek, a tributary of the Little River, and store 202,500 acre-feet of water;



- and Double Mountain Fork Reservoir, would be located on Double Mountain Fork upstream from the confluence with the Salt Fork and would have a storage capacity between 215,254 and 280,417 acre-feet (BGWPG, 2001, TWDB, 2002).

The water management strategies for the Region O Planning Area include the construction of Post Reservoir on the North Fork Double Mountain Fork of the Brazos River in Garza County (LEWPG, 2001). Post Reservoir has been authorized by the Texas Commission on Environmental Quality (TCEQ), with a permit recently extended to allow completion by 2012, and would impound 57,420 acre-feet of water.

An additional major reservoir within the Brazos River drainage is included within the Region H Water Plan and has been authorized by the TCEQ. The proposed Allens Creek Reservoir would be located on Allens Creek just upstream from its confluence with the Brazos River in Austin County. It would impound more than 200,000 acre-feet of water and would divert water directly from the Brazos River (RHWPG, 2001).

The historical habitat within the Middle and Lower Brazos River has effectively been converted from habitat that once supported the smallmouth shiner to habitat comprised of thermal, physical, and morphological parameters no longer suitable to the shiner, largely resulting from impoundments within the basin. Although the last known record of the fish from the main stem downstream of Possum Kingdom Reservoir occurred over twenty years ago, remnant populations may still exist in areas of suitable habitat. However, the suitable habitat remaining may be fragmented to the extent that any surviving populations are no longer viable. The continued effects of the existing impoundments coupled with the potential future water management strategies outlined in the Regional Water Plans seriously discount the possibility of recovery of the shiner in the Middle and Lower Brazos River.

Within the Upper Brazos River system, smallmouth shiners are most common within the higher order streams (Ostrand, 2000) with suitable flow and conductivity. The flow within the headwater reaches of the Double Mountain and Salt Forks is intermittent and often restricted to large pools within the channel. Under the harsh conditions that accompany the non-flow periods, smallmouth shiners are among the first species to be eliminated within the pools (Ostrand and Wilde, 2001).

The isolated pools of the Upper Brazos tributaries are unlikely suitable for successful reproduction of the smallmouth shiner (Wilde and Ostrand, 1999). Its persistence in these upper reaches is most likely the result of recolonization from populations occurring downstream during times of normal flow (Wilde and Ostrand, 1999; Ostrand and Wilde, 2001). However, the headwaters may be significant to the reproductive success of the shiner. Reproduction may be triggered by flood events, allowing shiners to move into the headwaters where eggs would be released and transported by currents downstream to perennial areas (Wilde, pers. comm.). Reservoir construction on the Upper Brazos tributaries would create a barrier between the base population and the upper reaches, preventing recolonization and potentially reducing reproductive success.

The headwaters of the Double Mountain Fork of the Brazos River in Garza County were isolated from the downstream reach in 1991 by the construction of the John T. Montford Dam, which impounds Alan Henry Reservoir. Upstream of the reservoir, the once common smalleye shiner has apparently disappeared following the completion of the dam (Wilde and Ostrand, 1999). A similar situation could occur on the Double Mountain Fork downstream of Alan Henry Reservoir and on the North Fork Double Mountain Fork, should the Double Mountain Fork and Post Reservoir projects be implemented. The potential direct impacts to the shiner resulting from construction of these reservoirs include 1) the inundation of occupied habitat, 2) the local extinction of upstream populations, and 3) the loss of habitat downstream from the dams due to the modification of necessary abiotic components (flow regime, thermal regime, substrate, conductivity, etc.).

*Chloride Control Reservoirs* - The streams of the Upper Brazos River Basin are characterized by natural salts that originate within the salt and gypsum terrain and an underlying brine aquifer within this region. Because the salt entering the Brazos River in this area limits its use as a practical water supply, several studies on the feasibility of salt control have been conducted (e.g., Johnson et al., 1982).

Options within the Region G Water Plan for the control of naturally occurring chlorides include deep well injection of recovered brine from the aquifer and the construction of Kiowa Peak Reservoir for the disposal of recovered brine. The Kiowa Peak Reservoir would be located on North Croton Creek just upstream from the confluence with the main stem Brazos (Stonewall and King Counties) and have a storage capacity of 659,650 acre-feet. The original design and study on Kiowa Peak was done by the U.S. Army Corps of Engineers and included the two additional salt retention reservoirs - Dove, located on Haystack Creek (Stonewall and King Counties), and Croton, located on Croton Creek in Stonewall and Kent Counties (Johnson et al., 1982).

The smalleye shiner evolved to prosper in the saline and turbid conditions naturally occurring in the Brazos River. The various chloride control projects proposed for the Upper Brazos for the conversion of the natural saline waters to a quality available for human consumption would modify the chemical characteristics conducive to smalleye shiner habitat. Additionally, those projects that require the construction of brine retention reservoirs may also inundate shiner habitat and reduce instream flows to the major tributaries (i.e., the Salt Fork), as well as the Brazos River proper.

*Existing Reservoir Enhancement* - An alternative to water management within the Brazos River Basin is expanding the available yield in an existing reservoir by increasing the conservation pool level, water diversion to temporary storage, and construction of a new embankment downstream from the current one. Within the Brazos River Basin, potential Region G projects related to existing reservoir supply include increasing the storage of Leon Reservoir (conservation pool raise) in Eastland County, water diversion from California Creek into Stamford Reservoir (Haskell County), water diversion from Sweetwater Creek into Sweetwater Reservoir (Nolan County), water diversion from Battle Creek into Cisco Reservoir (Eastland

County), increasing the storage of Waco Reservoir in McLennan County, and increasing the storage in Fort Phantom Hill Reservoir (new downstream embankment) in Jones County. These projects would contribute to the documented effects impoundments cause to river systems, especially regarding flow regime, within the existing range of the smalleye shiner.

*Discharges and Sedimentation* - In 1996, 329 domestic facilities (i.e., municipal wastewater) and 172 industrial facilities held permits by the state (TNRCC, 1996) within the Brazos River Basin. In 2000, 639 domestic and 350 industrial facilities were permitted within the basin (TNRCC, 2000). Permits held by domestic and industrial facilities allow for the discharge of treated and untreated effluent into the basin. Within the Upper Brazos River drainage alone, the sum of permitted facility discharges is more than 6,670 million gallons of effluent per day (U.S. Fish and Wildlife Service, unpublished data). These discharges modify water quality and add to the continued alteration of the Brazos River channel, affecting its morphology and substrate composition. Adverse conditions within the channel, such as low dissolved oxygen, causing fish kills result from these discharges when sewage facilities fail.

Silt and sediment entering streams via stormwater runoff is a primary source of impairment to surface waters in the United States (USEPA, 2002). The predominant land use within the Brazos River Basin is agriculture. The practices that accompany agricultural operations, including harvesting, tilling, and native vegetation clearing contributes to sediment entering the Brazos River system and the conversion of the natural substrate to silt and mud bottom. This source, along with other development projects involving significant earth disturbance resulting in excessive sedimentation within the Brazos River, reduces the available habitat for the smalleye shiner.

In 1996, 282 agricultural facilities (i.e., CAFOs) were permitted by the state (TNRCC, 1996) within the Brazos River Basin. The state reported 820 agricultural permits within the basin in 2000 (TNRCC, 2000). The wastes associated with CAFOs are typically high in nutrients (i.e., nitrogen and phosphorus compounds) and historically discharges of these wastes to surface water bodies have resulted in degraded water quality and wildlife mortality (Baker et al., 1998). CAFOs are not permitted to discharge into Waters of the United States except during severe weather events that exceed in intensity a 25-year rainfall event in a 24-hour period. In addition, during periods of intense rainfall and high flooding, retention structures can fail and lead to severe pollution to water bodies, which results in fish kills due to the inability of the watershed to filter or dilute the heavy nutrient load. Although discharge from CAFOs is not allowed by permit under normal conditions, unlawful discharge does occur. For example, from 1993 to 1998, the Environmental Protection Agency (EPA), under the Clean Water Act, documented 24 discharges from permitted CAFOs into Waters of the United States in Texas. Thirteen of these discharges were caused by chronic storm events and reported to the EPA, the remaining eleven were illegal discharges. From 1992 to 1999, the Texas Parks and Wildlife Department investigated over 60 fish kills attributable to anthropogenic causes (sewage discharge, oil spills, fertilizers, pesticides, etc.) and resulting in approximately 1,100,000 mortalities within the Brazos River Basin (TPWD, 2002).

Stormwater discharge and increased sedimentation within the Brazos River resulting from rock

mining may have contributed to habitat degradation in the Middle Brazos River region. Prompted by numerous complaints from private landowners of excessive sedimentation within a portion of the Brazos River in Palo Pinto and Parker Counties, the Texas Commission on Environmental Quality (TCEQ) implemented the Clear Streams Initiative to investigate rock mining facilities to determine levels of compliance with existing regulatory requirements (TCEQ 2004). Although TCEQ's September 2004 report concluded that rock mining facilities did not significantly affect the state's streams, numerous operational violations among permitted and unpermitted facilities were documented. Common violations were inadequate Best Management Practices, unauthorized discharges, and failure to monitor as required by the permit (TCEQ 2004). The continued operation of unpermitted rock mines and/or un-enforced mine violations occurring within the Brazos River Basin may pose a threat to the smallmouth shiner, especially if these facilities occur within the Upper Brazos River.

*In-stream Gravel Mining* - Within the Lower Brazos River, sand and gravel operations have mined the channel for many years (Dunn and Raines, 2001). In addition to the obvious short term direct impacts of dredging a river channel for collecting substrate, which may involve draglines, temporary island construction, removal of trees, excavation of settling pits, and heavy machinery within the channel, changes in the aquatic fauna may also occur. Forshage and Carter (1974) found major changes in both macroinvertebrate and fish populations resulting from an in-stream gravel operation within the Brazos River. In the absence of careful planning and appropriate mitigation measures, in-stream mining could also result in long term irreversible effects to the stream (Langer, 2002). The significance of the effects of these operations to the smallmouth shiner is not known.

B. Overutilization for commercial, recreational, scientific, or educational purposes. There is no current information that would suggest smallmouth shiners are over utilized for commercial, recreational, scientific, or educational purposes. Minnows of the genus *Notropis* are undoubtedly used as bait fishes and are probably harvested in the commercial bait industry. Commercial bait harvesters are required to obtain a permit and report annually on the species and numbers collected. However, the permit does not restrict the quantity of nongame fishes that can be harvested, and furthermore, the list of nongame fishes allowed for harvest under the permit specifies "*Notropis spp.*," which is likely the most detail submitted in an annual report. In 2002, four permits were issued for the harvest and sale of minnows from the Brazos River. Only two permittees reported a harvest in 2001. Currently, there is only one active permit for minnow harvest from the Brazos River. The impacts the commercial bait industry may have on the smallmouth shiner are unknown.

C. Disease or predation. The impact of disease or predation on the smallmouth shiner is not known. The State introduces game fish within the Brazos River and its impoundments, including some exotic species, which likely prey on smallmouth shiners. However, the extent of the effects of predation has not been determined.

D. The inadequacy of existing regulatory mechanisms. State law does not provide protection for the smallmouth shiner. There are no regulatory mechanisms for persons harvesting these minnows for use as bait fish, with the exception of a State fishing license and Nongame Fish Permit.

Permitted individuals are not restricted in quantity for bait fish harvests. See also the discussion under section B.

E. Other natural or manmade factors affecting its continued existence. The Upper Brazos region (upstream of Possum Kingdom Reservoir) is affected by the invasive exotic saltcedar (*Tamarix* sp.). Saltcedar was introduced in the United States from Eurasia as an ornamental plant in the late eighteenth century and has since escaped from cultivation and spread rapidly throughout the southwestern United States (Robinson, 1965). The rapid spread of saltcedar is likely an indirect result of reservoir construction and modification of natural river flows (Kerpez and Smith, 1987). The effects of saltcedar invasion on native ecosystems include, but are not limited to, alteration of stream/groundwater hydrology, displacement of native plant communities, and degradation of wildlife habitat (Kerpez and Smith, 1987). As of 1969, saltcedar was the most extensive flood plain community within the Upper Brazos River from Possum Kingdom Reservoir to the confluence of the Salt and Double Mountain Forks (approx. 521 river km [324 river mi]), covering approximately 28% of the flood plain, (Busby and Schuster, 1971). Blackburn et al. (1982) estimated saltcedar to have occupied 57% of the original Brazos River channel from the confluence of the mainstem and Clear Fork upstream to Seymour, Texas (129 river km [80 river mi]). The establishment of saltcedar in this region has slowed flood water velocity which has resulted in excessive sediment deposition and narrowing of the channel (Blackburn et al., 1982). The average width of this stretch of the river has narrowed from 157 meters (515 ft) in 1941 to 67 meters (220 ft) in 1979 (Blackburn et al., 1982).

The invasion of salt cedar within the Upper Brazos region that has resulted in modification of the channel, excessive sediment deposition, and altered flood stages is a threat to the smallmouth shiner. The smallmouth shiner requires fairly shallow, broad, open sandy channels with moderate current. The effects of dense saltcedar communities along the mainstem, Double Mountain and Salt Forks over time would render its natural habitat unsuitable. The magnitude of this threat is unknown and dependent on the extent and rate of saltcedar encroachment within the entire Upper Brazos River and its major tributaries; however, because the infestation occurs within the portion of the river supporting the majority of the known population shiners, the threat may be significant.

In recent years, the Brazos River has experienced massive blooms of golden algae (*Prymnesium parvum*) resulting in several fish kills. The alga kills by way of toxins released into the water that have a lethal effect on gill-breathing animals. Although little is known about the causes of golden algal blooms, as with many other algae, they may be triggered by excessive nutrient loading from point source and non-point source events such as industrial and municipal discharges and runoff from agricultural operations. The effects of the golden algae may be insignificant, but further information is necessary.

The current limited distribution of the smallmouth shiner within the Upper Brazos River Basin makes it vulnerable to catastrophic events occurring in this region. The shiner maintains populations within the harsh conditions of this area and can recover from droughts, provided the conditions of its habitat remain suitable. Catastrophic events such as the introduction of

competitive species or prolonged drought would increase the likelihood of extinction.

The potential for the introduction of competitive species is high due to the reports of such unintentional introductions by anglers and commercial bait fishermen. For example, the Red River shiner (*N. bairdi*) was apparently introduced into the range of the threatened Arkansas River shiner, and may seriously threaten its status. The Red River shiner is currently not known from the Brazos River, however, the probability of introduction is high, since the Red River Basin is immediately to the north of the current population of smallmouth shiners. Currently, there is no evidence that introduced species within the Brazos River effectively compete with the smallmouth shiner.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED: None.

SUMMARY OF THREATS: The threats to the smallmouth shiner consist of current and future reservoir development, in-stream sand and gravel mining, industrial and municipal discharges, agricultural activities, irrigation and water diversion, excessive sedimentation, and the spread of invasive saltcedar. Reservoir development within the Brazos River Basin is largely responsible for the modification of habitat within the river that has rendered major portions unsuitable for the smallmouth shiner. The three major impoundments of the Brazos River proper have apparently extirpated the smallmouth shiner from the Middle Brazos region and reduced it to relict populations within the lower portion of the river. Proposed reservoir development within the Upper Brazos region is a significant threat to the extant populations. While only one major reservoir is currently permitted (Post Reservoir), others are included in the Texas State Water Plan as a potential source to meet the demand for water to the year 2050. In-stream sand and gravel mining, excessive sedimentation, and industrial and municipal discharges coupled with the effect of impoundments, reduce the likelihood of the Brazos River sustaining viable populations of the smallmouth shiner downstream of Possum Kingdom Reservoir. Agricultural activities and the demand for water use (i.e., diversion and irrigation) within the Upper Brazos River also threatened the extant populations, especially due to the dry conditions of the region that often result in the lack of flow and isolated pools. The effect of saltcedar within the Upper Brazos region threatens the existing smallmouth shiner habitat. Saltcedar encroachment in the Upper Brazos and tributaries is likely an indirect result of impoundment of the river. These threats combined with the substantial reduction in historic range due to anthropogenic factors justify the candidate status of the smallmouth shiner.

For species that are being removed from candidate status:

\_\_\_ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

LISTING PRIORITY:

THREAT			
Magnitude	Immediacy	Taxonomy	Priority

<b>High</b>	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	<b>Non-imminent</b>	Monotypic genus	4
		<b>Species</b>	<b>5*</b>
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

*Magnitude:* The reduction in the historical distribution of the smallmouth shiner within the Brazos River Drainage is largely attributable to the continued modification of its habitat. The existing modifications to the river may limit the survival of any remaining populations and/or preclude the recovery of the shiner within the Middle and Lower Brazos River. The primary threat to the remaining stable population within the Upper Brazos region is the documented direct and indirect impacts of potential reservoir development within the basin. Currently, one major reservoir is authorized within the current range of the species. Several additional potential water development projects, including major reservoir sites, desalination, and existing reservoir enhancement, are options for meeting the future water demand in this region. For these reasons, we believe the magnitude of threat to the species is high.

*Imminence:* The potential water development projects within the Upper Brazos River basin, with the exception of the permitted Post Reservoir, are options for meeting the water needs in the area up to the year 2050 or beyond. Large reservoir development is usually a lengthy process that may extend for several years depending on funding, land acquisition, and local opposition. However, the potential for low-priority water projects to be elevated to high priority during subsequent planning cycles exists depending on many factors. At this time, we consider the immediacy of threats to the species is best categorized as non-imminent.

  X   Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed? Yes.

Is Emergency Listing Warranted? No. Stable populations of the smallmouth shiner currently exist in unmodified portions of its range.

**DESCRIPTION OF MONITORING:** Monitoring of the status of the smallmouth shiner currently consists of contact with local fisheries biologists (academic researchers and state biologists) who have expertise on the species. Correspondence was sent to Dr. Timothy Bonner (Texas State University), Dr. Frances Gelwick (Texas A&M University), Gordon Linam (Texas Parks and

Wildlife Department [TPWD]), Kevin Mayes (TPWD), Dr. Gene Wilde (Texas Tech University) and Kirk Winemiller (Texas A&M University) on August 30, 2005. This correspondence included specific requests on taxonomy and the threat of saltcedar invasion, and provided the information for obtaining the latest species assessment form. Earlier contact was also made with a subset of this group to inquire on specific research projects within the Brazos River and discuss the biology of the species and threats to its habitat. Some new information on recent collections and habitat was received from individuals in this group. Bob Gottfried of TPWD was also contacted for the current occurrence information maintained in TPWD's Biological Conservation Database, which was received on July 14, 2005. A literature search is performed at least once annually using two or more abstract databases, as well as an internet search engine, to locate newly published articles related to the species and the Brazos River. In 2004, the TPWD selected a proposal for research on the shiner for funding under section 6 of the Endangered Species Act. The study is being conducted by Dr. Gene Wilde of Texas Tech University and will investigate the distribution, status, habitat preference and reproductive ecology of the shiner within the Brazos River. This minimal level of monitoring is sufficient to update the status of the species the species' endemism to the state and the presence of experts employed with the state agency and local universities.

#### COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: The USFWS biologists within the state of Texas commonly work with their counterparts in the TPWD, the state agency responsible for conservation of Texas' fish and wildlife resources, in coordinating conservation and information on candidate species. As an added gesture, the TPWD was formally offered the chance to submit any outstanding data for the 2006 publication of the Candidate Notice of Review in an August 29, 2005, letter to the Executive Director of that agency. The TPWD responded to this request by providing species information on the candidates in Texas, however, no new information regarding the shiner was available.

Indicate which State(s) did not provide any information or comments: NA

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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: /s/ Rich McDonald 11/17/2005  
Acting Regional Director, Fish and Wildlife Service Date



Concur: \_\_\_\_\_ August 23, 2006  
Director, Fish and Wildlife Service Date

Do not concur: \_\_\_\_\_  
Director, Fish and Wildlife Service Date

Date of annual review: October 2005  
Conducted by: Omar Bocanegra